

DESIGN NOTES

High Voltage Current Mode Step-Down Converter with Low Power Standby Capability – Design Note 383

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Introduction

Low power standby requirements are typically associated with battery-powered systems. Automotive systems, for example, commonly require power supplies to maintain output voltage regulation even under no-load conditions—while drawing minimal quiescent current to preserve battery life. Rising energy costs, however, have extended the need for low current standby operation to line-powered systems, such as small plugged-in appliances for home and business.

Designing a power supply that is very efficient at light loads is particularly difficult in systems where high input voltages and substantial load currents are required. A common approach in such high power systems is to add a secondary power path for low current operation—a potentially significant increase in the cost, board space and complexity of the power supply.

A better solution is to use the LT[®]3800 as the core of a single-supply synchronous DC/DC converter. The resulting power supply is simple and efficient. An LT3800-based

converter requires few external components, maintains high conversion efficiencies over a wide load range and supports low power standby operation for compliance with system power-management requirements.

High Efficiency at Standby

The LT3800 is a $4V_{IN}$ to $60V_{IN}$, 200kHz fixed-frequency controller that uses synchronous operation and N-channel MOSFETs to maximize high current efficiency. Current mode operation with continuous high-side inductor current sensing yields fast transient response and excellent line regulation. Low current standby requirements are met using Burst Mode[®] operation. A reverse inductor current inhibit feature also increases efficiency during light-load conditions. The LT3800 runs directly from the converter input supply, so there are no local supplies required to power the IC. The IC is also designed for easy use of output-derived power which further increases conversion efficiency. Cycle-by-cycle current limiting maintains the

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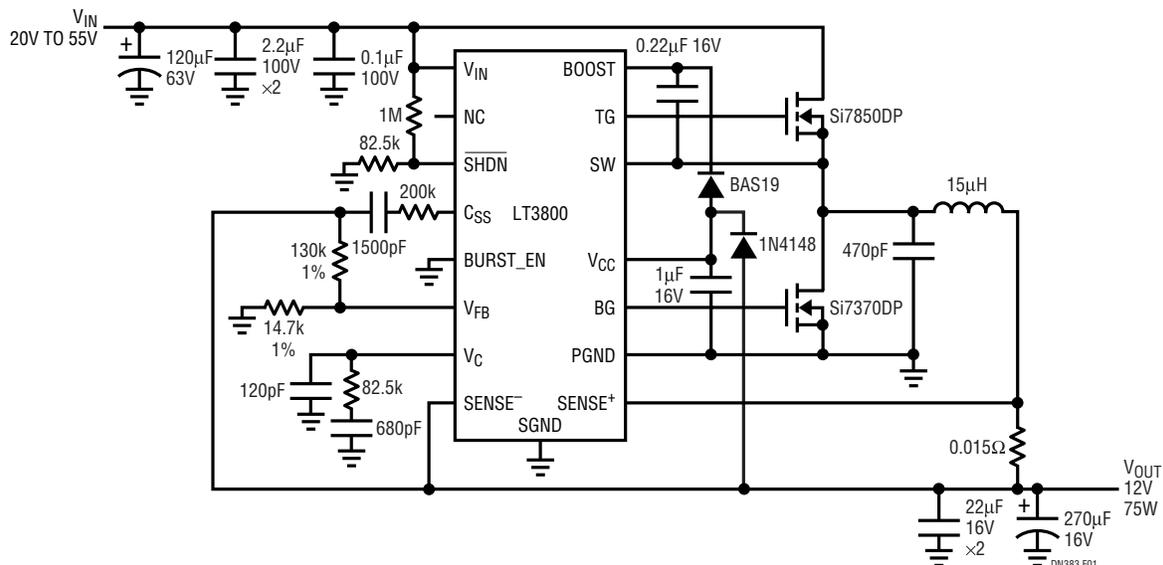


Figure 1. LT3800 12V, 75W Buck DC/DC Converter with High Efficiency at Light Loads

programmed current limit, even during instantaneous short circuit fault conditions.

12V/75W Synchronous Buck DC/DC Converter

Figure 1 shows a 12V, 75W DC/DC converter that can operate with input voltages from 20V to 55V. The 20V minimum input is set by a programmable UVLO function implemented using the precision hysteretic threshold of the LT3800 SHDN pin. The 55V upper bound is limited by switch FET margin. This converter provides full-load efficiencies above 95%, as shown in Figure 2, and can maintain a no-load output voltage with only 0.1mA of input supply quiescent current.

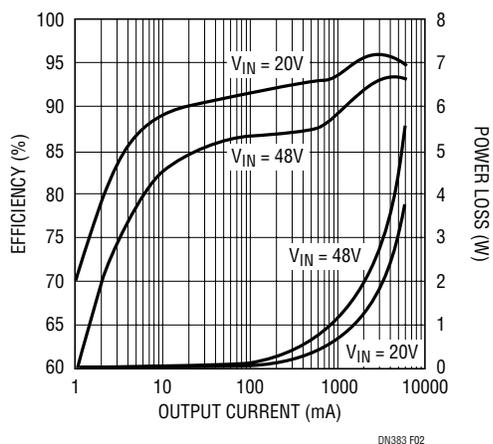


Figure 2. The DC/DC Converter in Figure 1 Exhibits High Efficiency Across a Wide Load Range and Produces Peak Efficiencies Above 95%

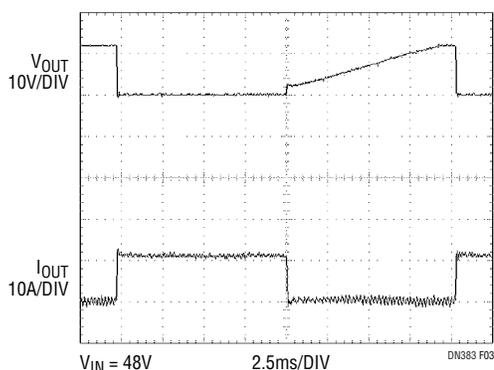


Figure 3. Current Limit is Maintained During Instantaneous Short-Circuit and Auto-Reset Soft-Start Yields a Graceful Recovery from the Fault Event

This DC/DC converter incorporates a controlled dV/dt soft-start function which serves the converter output voltage to a programmed rising rate during start-up—in this case 1.3V/ms, yielding a start-up rise time of just under 10ms. The LT3800 automatically resets the soft-start function if the output drops out of regulation, so recovery from a short circuit or brownout event is graceful and controlled.

The light load efficiency enhancement features of the LT3800 produce a supply that maintains high conversion efficiency across a 4-decade range. This DC/DC converter also features excellent heavy-load efficiency, producing peak conversion efficiencies as high as 96%.

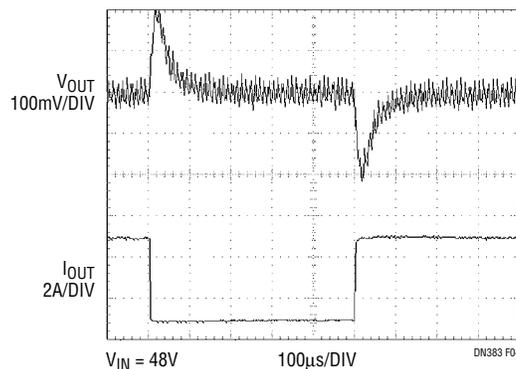


Figure 4. 1A to 5A Load Step Generates <2% V_{OUT} Transient

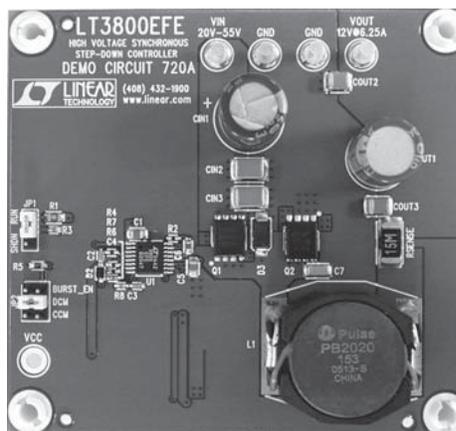


Figure 5. LT3800 12V, 75W DC/DC Converter Layout

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